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ABSTRACT

The Nested Spiral Approach (NSA) is a teaching technique designed for students of limited English proficiency that integrates four aspects of motivated learning: contents, language, culture, and real life experiences. The approach consists of: (1) effective use of student strengths; (2) three teaching cycles for each lesson; and (3) five steps in each cycle. Preliminary use of NSA to teach mathematics at the junior high school level has been successful, raising achievement in both the subject area and English language skills and promoting self-esteem, confidence, and learning motivation. The technique can also be used in science instruction. The three instruction cycles (basic, intermediate, advanced) emphasize subject matter learning with opportunities to learn from different perspectives. Each cycle or level is correlated with an area of English language proficiency (vocabulary; grammar and simple sentence structure; and science reading comprehension, respectively). The five steps of preview, exploration, discussion, exercise, and review are carried out in each cycle, fostering critical thinking, planning, predicting, interpreting, and evaluating skills while imparting science content. A brief description of the cycles and related class activities illustrates the suggested approach. A brief bibliography is included. (MSE)

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Teaching Science to Students with Limited English Proficiency through Nested Spiral Approach

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Nested Spiral Approach (NSA) is an integtrated teaching approach designed for inducing effective learning in subject areas on the part of students with limited English proficiency (LEP) (Chyu,1989). This approach pays special attention to LEP students' needs and strengths, and makes full use of the strengths in connection with hands-on activities for promoting their learning. It extends,supplements existing educational,instructional theories to activate the interactive characteristics among four aspects of motivated learning (contents, languages, culture and real life experiences) and situate them into proper perspective through (1) effective utilization of students' strengths, (2) three teaching cycles for each lesson, (3) five steps in each cycle. It is both a theory and a practical mechanism for implementing optimal teaching techniques and strategies. Additionally, since instructional strategies and curriculum are the two phases of teaching, NSA can also serve as a guideline model in curriculum design and lesson planning.

Preliminary trial use of NSA has been conducted, with encouraging results, to mathematics classes of the target population at junior high level. After receiving instruction on the basis of this approach, LEP students progressed significantly both in mathematics competency and English proficiency. As a result, their self esteem and confidence were enhanced and their attitude towards learning was improved. Moreover, they showed much

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more interest in learning than before. Consequently, a snowball rolling effect for promoting learning is in place.

Science and mathematics go hand in hand, with the help of a "bridge" called problem solving. This bridge and its dynamic functions derived from hands-on activities in science education for LEP students coincide with the central theme of NSA. Thus, it is anticipated that NSA can also yield favorable results for teaching science to LEP students. Two points are of special significance here. First, language arts can link students' real life experiences with their appreciation and understanding of science. Second, science experiments of any sophistication and related learning activities guided by NSA can foster ideal environment for LEP students to pursue meaningful learning of science. The starting point for such a pleasant and productive learning is their current academic preparation ,coupled with their growth in affective domain,namely, praising and utilizing their strengths. For example, they are not only interested in voluntarily participating in learning activities emphasing on experiments, but also are very good at such endeavors,resulting in excellent achievement which directly elevates their self esteem. This increase in confidence further spurs motivation to learn more and better. Thus, a self propelling learning cycle is set up in motion. That is the spirit of NSA.

The purpose of this paper is to illustrate, via an example, the application of NSA in teaching science to LEP students.

The three instruction cycles emphasize three levels of

competency in subject matter while providing students with various opportunities to learn from different view points. The three levels are designated as basic, intermediate, and advanced. Each level stresses a set of specific objectives concerning science competency and English language proficiency (see table below).

OBJECTIVES AT THREE LEVELS

Level	Science Contents	English Language Proficiency
I	Concepts	Vocabulary
II	Principles	Grammar, simple sentence making
III	Applications	Science reading comprehension

These objectives are realized by using three cycles, each cycle corresponding to one level. The five steps of preview, exploration, discussion, exercise, and review which constitute the concrete mechanism for NSA are carried out in each cycle, fostering critical thinking, planning, predicting, interpreting and evaluating skills as well as implanting science contents. The following is an outline of three cycles in operation.

Consider the interesting and familar problem of the motion of a physical body sliding down a sloped plane surface. A learning procedure on the basis of NSA might go in the manner described below.

Cycle 1. The resourceful teacher, as a facilitator as well as a leader, can catch students' attention and foster their genuine interest in learning by starting with, for example, the question, "What does the word 'slide' mean?" As a noun, it could mean a smooth surface for children to play, or a glass plate, or a picture on phoptographic film. It could be a verb too,of course. Here a

vivid contrast between two languages and cultures is in place. This will arouse students' interest in languages and science which are interlaced in real life experiences.Enjoying a culturally rich environment, students can benefit greatly from a relaxed learning atmosphere. Thus, story telling about subject matter, daily life, language arts, and culture are in order. This will lead to further exploration which can proceed in the following fashion:

1. Let two groups of students do model sliding surfaces with various roughness, and a timber block of suitable size respectively.

2. Students are encouraged to try out an experiment of letting a timber block slide down the sloped surface for fun. They will associate this with the pleasant memory of past experiences in playground. Teacher is to motivate them in each and every way possible to actively participate in discussing personal experiences in learning,playing. Students should try to use proper English expressions to describe their learning activities.This is aided by their knowledge in L1 under teacher's direction.

3. Let students make standard forms for charts,tables needed for recording the results of experiments .Main features of the experiments are layed out clearly in advance for facilitationg concentration.

4. The teacher can demonstrate the significance of equipment prepared thus far while introducing the concepts of forces, friction,weight,slope of sliding surface,time of travel in an informal manner,in L2 supplemented with L1.

Cycle 2. The students are now ready for receiving instruction

in L2 aided with L1 and hands-on experiences. Simple experiements are carried out as follows:

First, keeping the slope of the sliding surface constant, several groups of students are investigating the effects of roughness of the contact surfaces.First,measurements are made in advance. Then, group A performs the task of letting the block slide down the sloped surface. Group B keeps records of time of motion and other data. Group C observes the experiment under teacher's supervision. The results are presented in tables and graphs. Concrete conclusions are drawn in simple language. These are then reviewed by teacher immediately with comments on both contents and use of language. Sentence making is a tool for expressing the experiments just performed. Basic vocabulary learned from cycle 1, and simple grammar are applied here under teacher's guidance. Science principles, rules involving velocity, distance, acceleration, slope and roughness of contact surfaces are formulated in language that is easily comprehensible by students.

Similarly, the effects of varying the slope of the sliding surface only are explored by another group of students.

The step of discussion, including the contrasting between the two experiments, follows in a natural way. Exercises based on these results can reinforce, at the right time,the principles in science thus learned. This will pave way for further study in cycle 3. Review of what have been done so far can provide insight into the significance of this interesting process.

Cycle 3. After being attracted by the exciting features of

the simple and yet illuminating experiments,students are ready to extend the scope of applicability to other problems, either in terms of contents or methodology. A stimulating and thought provoking example is to apply it to a supermarket for moving grocery boxes from a truck. Look at the question, "What specific things need special attention?" Is it the slope of a slide? How many slides are needed for accommodationg change of direction of motion and space limitations? Also, students ought to digest what have been learned in pain English. Can they comprehend similar topic, written in English, with ease now? How about the problem of rolling a ball down a sloped surface? Or throwing a ball up the sloped surface? These questions not only provide challenge in reading comprehension, but also enhance reinforcing and application of science to other problems in daily life or in academic settings for future endeavors.

Cultural aspect of learning as well as its interrelation with science contents, daily life, and language arts acquisition can best be tactically mingled in the instruction, especially in steps "discussion", "exploration". It should and can be touched upon during "review" step. Additionally, cultural aspect often enables us to device a very effective starter for a new lesson or topic. Consequently, it is also valuable for the step "preview". This is due to its effectiveness to motivate students to learn.

The above example illustrates ,in a nutshell,NSA at work, along with its fundamental guiding principles that generate useful instructional tactics as well as aid in developing adequate lesson plans.

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